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Freshwater Algae from Mesopotamia

Minoru HIRANO

The freshwater algal material collected by the Botanical Expedition to the northern Highland of Mesopotamia, 1970, under Dr. K. YAMASHITA, Professor of Biology of Kyoto University, to make an extensive study of the wild wheat and its allied species, was turned over to me by himself for examination. These samples were collected by himself and Miss Y. IWAKAWA, one of the member of the Expedition. Although they are rather limited, these alga samples are most interesting to me because the knowledge of the algal flora in Mesopotamia has not been investigated yet except for the study of diatoms from the area (Mesopotamia and Kurdistan) reported by R.W. KOLBE and KRIEGER (1942) based on the material collected by the HANDEL-MAZETTI's Expedition in 1910. There are several reports about the algal flora of the neighboring countries of Mesopotamia (Iraq) including the area of Asia Minor: SCHRÖTER (1895), BRUNNTHALER (1903), ZEDERBAUER & BREHM (1907), and SKUJA (1937). The information of the algal flora of the eastern side of Mesopotamia, i.e., Afghanistan, Iraq and Central Asia, was reported by the following persons: STOCKMAYER (1909), BOYE PETERSEN (1927), SKUJA (1932), FOGED (1959), and HIRANO (1964).

The present Mesopotamian material examined consists chiefly of diatoms and a limited number of green algal species. The reason may be due to the fact that the material was collected from the running water such as small, spring-fed streams. Some of the samples including species of green and blue-green algae were collected in pools and in standing water localities along the river side of the Euphrates River.

The following is a brief description of 21 stations where the alga samples were obtained (see map of Fig. 1 in the text).

Stations

1. Tizhtiz, a stream in front of the tea shop. 17th July, 1970. Collected by K. YAMASHITA.
2. The bottom of a water-fall at Gali. 11th June, 1970. Collected by Y. IWAKAWA.
3. Koi Sanjaq, a small stream from an oasis. The water is clear. Collected by K. YAMASHITA.
4. A pond at Amadiya. 17th June, 1970. Collected by Y. IWAKAWA.
5. A stream at Sinjar. 7th June, 1970. Collected by Y. IWAKAWA.

6. A clear stream from a spring at Bakhal. Two samples. 11th June, 1970. Collected by Y. IWAKAWA.

7. A Baghdad hotel at Shaqlawa. A collection was made at a small artificial stream for irrigation in the garden of the hotel. 10th May, 1970. 3 samples. Collected by Y. IWAKAWA.

8. Ardin

9. A stream 70 km west from the Kermanshah. 16th July, 1970. Collected by K. YAMASHITA.

10. A stream at the Agricultural Experimental Station at Abgreb, Iraq. 2 samples. 27th June, 1970. Collected by Y. IWAKAWA.

11. A place called Heltoshan 75 km west from the tea shop at Kermanshah. 17th July, 1970. Collected by K. YAMASHITA.

12. A water course for irrigation before the Ramsar hotel. 20th July, 1970. Collected by K. YAMASHITA.

13. A spring to the east of Koi Sanjaq. 8th June, 1970. Collected by K. YAMASHITA.

14. A small pond at the river-bed of the Tigris. 26th June, 1970. 2 samples. Collected by K. YAMASHITA.

15. A water sourse of the Caspian river near the pass toward Rasht. The water is clear. 19th July, 1970. Collected by K. YAMASHITA.

16. A small pond at the statue of Ferdowsi. 11th July, 1970. Collected by K. YAMASHITA.

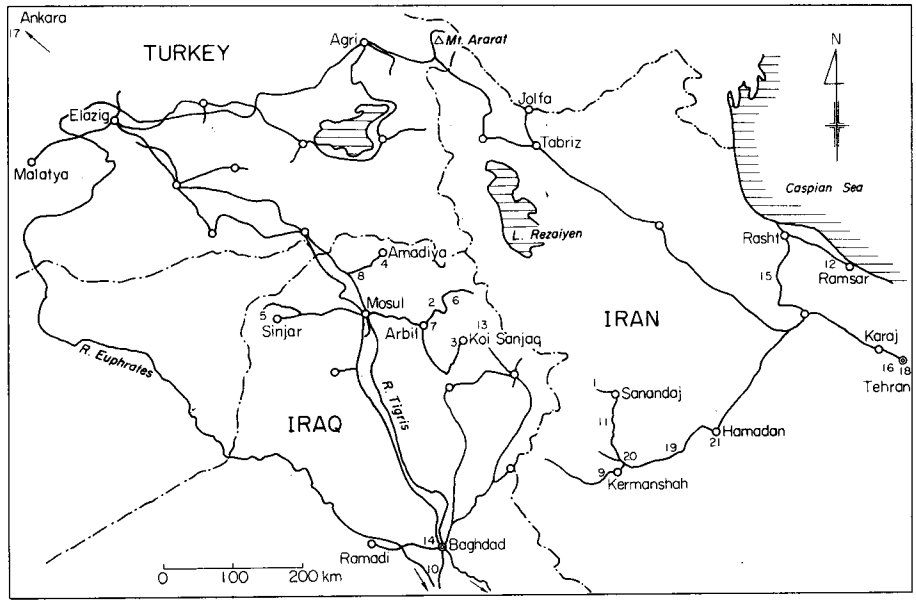

Fig. 1. Map of the Mesopotamian district

17. A pool in the park of Ankara. There is a fountain. 6th June, 1970. Collected by K. YAMASHITA.

18. An artificial pool in the garden of Fine Art Museum, the city of Tehran. 9th July, 1970. Collected by K. YAMASHITA.

19. A stream near the pass between Kermanshah and Hamadan. 19th July, 1970. Collected by K. YAMASHITA.

20. A spring in the park of Kermanshah. 16th July, 1970. Collected by K. YAMASHITA.

21. A pond with a fountain at the rotary section of Hamadan. 16th July, 1970. Collected by K. YAMASHITA.

These collecting places are marked by the numbers on the map of the Mesopotamian district.

I wish to express my thanks to a friend of mine, Dr. Kosuke YAMASHITA, and Miss Yoko IWAKAWA, for providing me with a rare opportunity to study this interesting material from Mesopotamia with their kind information about the collecting sites.

CYANOPHYTA

Chroococcaceae

Chroococcus minutus (KÜTZ.) NÄG. in GEITLER, Süssw.-fl. 12, p. 79, f. 74, 1925.
Cells 4–5 μ in diameter. Hab. 10, 16.

Merismopedia glauca (EHRENB.) NÄG. in GEITLER, l.c. p. 106, f. 125, 1925.
Cells 3.5 μ in diameter. Hab. 2, 6.

Merismopedia punctata MEYEN in GEITLER, l.c. p. 106, f. 124, 1925.
Cells 2.5–3 μ in diameter. Hab. 1, 3, 15.

Oscillatoriaceae

Oscillatoria agardhi GOM. in GEITLER, l.c. p. 369, f. 455, 1925.
Cells 5.7–6 μ in diameter. Hab. 2, 5, 7, 11.

Oscillatoria amoena (KÜTZ.) GOM. in GEITLER, l.c. p. 370, f. 450, 1925.
Cells 1 μ in diameter. Hab. 3.

Oscillatoria brevis KÜTZ. in GEITLER, l.c. p. 371, f. 457, 1925.
Cells 4.5–6 μ in diameter. Hab. 8, 10, 15.

Oscillatoria limosa AG. in GEITLER, l.c. p. 357, f. 420, 1925.
Cells 17.5 μ in diameter. Hab. 20.

Oscillatoria simplicissima GOM. in GEITLER, l.c. p. 364, f. 429, 1925.
Cells 8–9 μ in diameter. Hab. 9.

Phormidium angustissima W. & G. S. WEST in GEITLER, l.c. p. 377, 1925.
Cells 1 μ in diameter. Hab. 2.

Phormidium favosum (BORY) GOM. in GEITLER, l.c. p. 387, f. 492, 1925.
Diameter of cell 4.5 μ. Hab. 2.

Phormidium molle (KÜTZ.) GOM. in GEITLER, l.c. p. 378, f. 471, 1925.
Cells 3.5–5.3 μ in diameter. Hab. 11.

Phormidium papyraceum (AG.) GOM. in GEITLER, l.c. p. 384, f. 488, 1925.
Cells 3.5 μ in diameter. Hab. 1.

Phormidium retzii (AG.) GOM. in GEITLER, l.c. p. 383, f. 485, 1925.
Cells 6 μ in diameter. Hab. 1.

Phormidium uncinatum (AG.) GOM. in GEITLER, l.c. p. 388, f. 493, 1925.
Cells 6–7 μ in diameter. Hab. 7.

Lyngbya hieronymusii LEMM. in GEITLER, l.c. p. 401, 1925.
Cells 13.6 μ in diameter. Hab. 10.

Lyngbya limnetica LEMM. in GEITLER, l.c. p. 399. f. 504, 1925.
Cells 1–1.8 μ in diameter. Hab. 10, 16.

Lyngbya nigra AG. in GEITLER, l.c. p. 405, f. 518, 1925.
Cells 8 μ in diameter. Hab. 1.

CHLOROPHYTA

Oocystaceae

Tetraedron caudatum (CORDA) HANSG. in PRESCOTT, Alg. Great Lake Area p. 263, pl. 59, f. 17, 24, 25, 1951.
Hab. 10.

Hydrodictyaceae

Pediastrum boryanum (TURP.) MENEGH. in BRUNTHALER, Süssw.-fl. 5, p. 100, f. 61a, 1915.
Hab. 10.

Pediastrum integrum NÄG. in BRUNNTHALER, l.c. p. 91, f. 51a, 1915.
Hab. 1, 10, 21.

Pediastrum simplex (MEYEN) LEMM. in PRESCOTT, l.c. p. 227, pl. 50, f. 2, 1951.
Hab. 10.

forma ***sturmii*** (REINSCH) G. S. WEST in Journ. Linn. Soc. Bot. **38**, p. 133, 1907. —*Pediastrum sturmii* REINSCH in Alg. Frank. p. 90, pl. 7, f. 1, 1867.
Hab. 10.

Scenedesmaceae

Scenedesmus abundans (KIRCHN.) CHODAT in PRESCOTT, l.c. p. 274, pl. 61, f. 21, 1951.
Hab. 21.

Scenedesmus dimorphus (TURP.) KÜTZ. in PRESCOTT, l.c. p. 277, pl. 63, f. 8, 9, 1951.
Hab. 10.

Scenedesmus obliquus (TURP.) KÜTZ. in PRESCOTT, l.c. p. 279, pl. 63, f. 17, 1951.
Hab. 10.

Scenedesmus protuberans FRITSCH & RICH in Trans. Royal Soc. S. Africa **18**:1, p. 31, f. 6, 1929.
Hab. 10.

Scenedesmus quadricauda (TURP.) BRÉB. in PRESCOTT, l.c. p. 280, pl. 64, f. 2, 1951.
Hab. 10.

Desmidiaceae

Penium rufescens CLEVE in W. & G. S. WEST, Monogr. Brit. Desm. **1**, p. 99, pl. 6, f. 12, 13, 1904.
Cell 53 μ long, 22 μ broad. Hab. 2.

Closterium Ehrenbergii MENEGH. in WEST, l.c. **1**, p. 143, pl. 17, f. 1–4, 1904.
Cell 484 μ long and 92 μ broad. Hab. 7.

Closterium lanceolatum KÜTZ. in WEST, l.c. **1**, p. 149, pl. 17, f. 9, 10, 1904.
Cell 308 μ long and 57 μ broad. Hab. 7.

Closterium littorale GAY in WEST, l.c. **1**. p. 155, pl. 19, f. 14, 1904.
Cell 172–211 μ long and 17–20 μ broad. Hab. 1, 19.

Closterium Lunula (MÜLL.) NITZSCH in WEST, l.c. **1**, p. 150, pl. 18, f. 8, 9, 1904.
Cell 685 μ long and 20 μ broad. Hab. 13.

Closterium pseudolunula BORGE in KRIEGER, Krypt. Fl. **13**, Abt. 1, p. 305, pl. 22, f. 3, 1935.

Cell 220–286 μ long and 37–44 μ broad. Hab. 7, 19.

Closterium strigosum BRÉB. in WEST, l.c. **1**, p. 165, pl. 21, f. 6, 7, 1904.
Cell 352 μ long and 15.4 μ broad. Hab. 21.

Tetmemorus laevis (KÜTZ.) RALFS in WEST, l.c. **1**, p. 222, pl. 32, f. 11–16, 1904.
Cell 62 μ long and 18.5 μ broad. Hab. 14.

Cosmarium globosum BULNH. in WEST, l.c. **3**, p. 219, pl. 68, f. 1, 2, 1908.
Cell 26.5 μ long, 17.6 μ broad, and isthmus 13 μ broad. Hab. 14.

Cosmarium laeve RABENH. in WEST, l.c. **3**, p. 99, pl. 73, f. 8–19, 1908.
Cell 22–23.8 μ long, 15.4–17.6 μ broad, and isthmus 5.3 μ broad. Hab. 2, 10.

Cosmarium pseudonitidulum NORDST. in WEST, l.c. **3**, p. 195, pl. 63, f. 26, 1905.
Cell 28–37.8 μ long, 22–26.5 μ broad, and isthmus 5.7–9 μ broad. Hab. 9, 10, 16.

Cosmarium subtumidum NORDST. in WEST, l.c. **2**, p. 192, pl. 63, f. 18–20, 1905.
Cell 24.6–39.6 μ long, 20–32 μ broad, and isthmus 6.5–9.5 μ broad. Hab. 18, 21.

Cosmarium undulatum CORDA in WEST, l.c. **2**, p. 148, pl. 59, f. 1–3, 5, 1905.
Cell 25.5 μ long, 17.6 μ broad, and isthmus 5 μ broad. Hab. 6.

Cosmarium variolatum LUND. var. ***polygonum*** GERLOFF in Gatt. Cosm. p. 118, pl. 24, f. 15, 1965.
Cell 22–24 μ long, 14–15.4 μ broad, and isthmus 4.2 μ broad. Hab. 7, 16.

Arthrodesmus phimus TURNER in W. & G. S. WEST, l.c. **4**, p. 104, pl. 115, f. 15, 16, 1911.
Cell without spine 22 μ long, 20 μ broad without spine, and isthmus 6 μ broad. Hab. 1.

Staurastrum margaritaceum (EHRENB.) MENEGH. in WEST & CARTER, Monogr. Brit. Desm. **5**, p. 131, pl. 150, f. 5–9, 1923.
Cell 32.7 μ long, 26.5 μ broad, and isthmus 8.7 μ broad. Hab. 1.

Gymnozyga moniliformis EHRENB. in WEST & CARTER, l.c. **5**, p. 255, pl. 165, f. 8, 9, 1923.
Cell 26 μ long and 18 μ broad. Hab. 1.

CHRYSOPHYTA

DIATOMEAE

Coscinodiscaceae

Melosira granulata (EHRENB.) RALFS in HUSTEDT, Süssw. -fl. **10**, p. 87, f. 44, 1930.

Valve 6 μ in diameter. Hab. 8.

Melosira varians C. A. AG. in HUSTEDT, l.c. p. 85, f. 41, 1930.

Valve 12 μ in diameter. Hab. 4.

Cyclotella Meneghiniana KÜTZ. in HUSTEDT, l.c. p. 100, f. 67, 1930.

Valve 10 μ in diameter. Hab. 19.

Fragilariaceae

Diatoma hiemale (LYNGB.) HEIBERG in HUSTEDT, l.c. p. 129, f. 115, 1930.

Valve 17 μ long and 8.5 μ broad. Hab. 2, 7.

Diatoma elongatum (LYNGB.) AG. var. ***tenue*** (AG.) V. H. forma ***normalis*** KÜTZ. in A. CLEVE, K. V. Akad. Handl. **4**:1, p. 24, f. 331c, 1953.

Valve 34 μ long and 7 μ broad. Hab. 7.

Meridion circulare AG. in HUSTEDT, l.c. p. 130, f. 118, 1930.

Valve 20 μ long and 5 μ broad. Hab. 7.

Fragilaria construens (EHRENB.) GRUN. var. ***venter*** in A. CLEVE, K. V. A. Handl. **4**:1, p. 34, f. 346i-k, 1953.

Valve 10 μ long and 5 μ broad. Hab. 7.

Fragilaria intermedia GRUN. in MAYER, Denkschr. Bayer Bot. Ges. Regensb. **22**, n.f. 16, pl. 1, f. 9–11, 1946.

Valve 21 μ long and 5 μ broad. Hab. 7.

Fragilaria vaucheriae (KÜTZ.) BOYE-PETERS. in A. CLEVE, K. V. A. Handl. **4**:1, p. 42, f. 353a, c, 1953.

Valve 23 μ long and 3.5 μ broad. Hab. 7.

var. ***parvula*** (KÜTZ.) A. CLEVE in K. V. A. Handl. **4**:1, p. 43, f. 353d, h, i, 1953.

Valve 22 μ long, 4.5 μ broad, and striae 12 in 10 μ. Hab. 7.

Synedra ulna (NITZSCH) EHRENB. in HUSTEDT, l.c. p. 151, f. 158, 159, 1930.

Valve variable in form and size, 70–200 μ long, 8–10 μ broad, and striae 10–11

in 10 μ, pseudoraphe linear not dilated in the middle or having a slightly dilated central area. Hab. 4, 5, 7, 9.

Achnanthaceae

Cocconeis placentula (EHRENB.) HUSTEDT in l.c. p. 189, f. 260, 1930.
Valve 30 μ long and 17 μ broad. Hab. 9.
var. ***lineata*** (EHRENB.) CLEVE in HUSTEDT, l.c. p. 190, f. 262, 1930.
Valve 24 μ long and 13.5 μ broad. Hab. 4.

Achnanthes lanceolata BRÉB. in HUSTEDT, l.c. p. 207, f. 306a, 1930.
Valve 20–27 μ long and 6–6.5 μ broad. Hab. 8.

Achnanthes minutissima KÜTZ. in HUSTEDT, l.c. p. 198, f. 274, 1930.
Valve 18 μ long and 2.5 μ broad. Hab. 1.
var. ***cryptocephala*** GRUN. in HUSTEDT, l.c. p. 198, f. 275, 1930.
Valve linear-lanceolate with slightly capitate ends, axial area narrow lanceolate and dilated at the central area into the rectangular form, striae dense and not recognizable. Valve 18 μ long and 3 μ broad. Hab. 1.

Frustulia rhomboides (EHRENB.) De TONI in HUSTEDT, l.c. p. 220, f. 324, 1930.
Valve 85 μ long and 17 μ broad. Hab. 7.

Frustulia vulgaris (THWAITES) CLEVE in HUSTEDT, Krypt. Fl. 7:2, p. 730, f. 1100a, 1937.
Valve 50 μ long and 10 μ broad. Hab. 7.
forma ***parva*** A. CLEVE in K. V. Akad. Handl. 3:3, p. 9, f. 1329c, 1952.
Valve 37–41 μ long and 7–7.7 μ broad. Hab. 2.

Gyrosigma kuetzingii (GRUN.) GLEVE in HUSTEDT, l.c. p. 224, f. 333, 1930.
Valve 57–100 μ long and 11.7–16.5 μ broad. Hab. 2, 7, 11, 12.

Caloneis bacillum (GRUN.) MERESCHKOWSKY in HUSTEDT, l.c. p. 236, f. 360, 1930.
Valve 50 μ long, 9.5 μ broad, and striae 20 in 10 μ. Hab. 19.

Caloneis silicula (EHRENB.) CLEVE var. ***truncatula*** GRUN. in SKVORTZOW, Publ. Mus. Hoangho Paiho Tien Tsin no. 36, p. 19, pl. 4, f. 16, 1935.
Valve 48–61 μ long, 12 μ broad, and striae 16–18 in 10 μ. Hab. 1.

Neidium dubium (EHRENB.) CLEVE in HUSTEDT, l.c. p. 246, f. 384, 1930.
Valve 36 μ long, 12 μ broad, and striae about 20 in 10 μ. Hab. 1.

Diploneis marginestriata HUSTEDT in l.c. p. 250, f. 393, 1930.
Valve 38 μ long, 11 μ broad, and striae 15–16 in 10 μ. Hab. 2.

Stauroneis Smithii GRUN. var. ***karelica*** WISL. & KOLBE in A. CLEVE, K. V. Akad. Handl. 4:5, p. 216, f. 957e, 1953.

Valve 17 μ long, 5 μ broad. Hab. 1.

Navicula cryptocephala KÜTZ. in HUSTEDT, l.c. p. 295, f. 496, 1930.

Valve 37–38 μ long, 8 μ broad, and striae 15 in 10 μ. Hab. 1, 7, 11.

var. ***exilis*** (KÜTZ.) GRUN. in HUSTEDT, l.c. p. 295, 1930.

Valve 28 μ long, 6 μ broad, and striae 14 in 10 μ. Hab. 1.

var. ***intermedia*** GRUN. in HUSTEDT, l.c. p. 295, f. 497b, 1930.

Valve elliptic-lanceolate with long rostrated and rounded apices, striae radial in the centre and convergent at the end. Valve 34–58 μ long, 7–10 μ broad, and striae 12 in 10 μ. Hab. 1, 7, 11.

var. ***veneta*** (KÜTZ.) GRUN. in HUSTEDT, l.c. p. 295, f. 497a, 1930.

Valve 17–22 μ long, 5–7 μ broad, and striae 13 in 10 μ. Hab. 2, 3, 4, 5, 7, 8.

Navicula cuspidata KÜTZ. var. ***ambigua*** (EHRENB.) CLEVE in HUSTEDT, l.c. p. 268, f. 434, 1930.

Valve 49–73 μ long, 15–20 μ broad, and striae 18 in 10 μ. Hab. 1, 14, 19.

Navicula gracilis EHRENB. in HUSTEDT, l.c. p. 299, f. 514, 1930.

Valve sublinear-lanceolate, margins slightly convex, ends broadly rounded not produced, axial area narrow linear, central area rectangular, striae slightly radial and central one short, slightly convergent at the end. Valve 46–54 μ long, 8.5–9 μ broad, and striae 9 in 10 μ. Hab. 1, 2, 4, 7, 8, 11.

Navicula Grimmei KRASSKE in HUSTEDT, l.c. p. 274, f. 448, 1930.

Valve 16 μ long, 6 μ broad, and striae 24 in 10 μ. Hab. 7.

Navicula Koeiei FOGED in Biol. Skr. Det. Kongel. Dansk. Vidensk. Selsk. **11**:1, p. 54, pl. 3, f. 10, 1959.

Valve 16–25 μ long, 5–7 μ broad, striae 18–20 in 10 μ and radiate and distinctly punctate, sides of valve almost straight in the median part and abruptly and rapidly narrowed toward the end which is subcapitate and truncate at the extremity. The present specimens are somewhat different from the original figure given by FOGED on the Afghanistan specimens in their narrower capitate ends of the valve. Hab. 1, 7, 11.

Navicula lanceolata (AG.) KÜTZ. in HUSTEDT, l.c. p. 305, f. 540, 1930.

Valve 32.5–36 μ long, 6–9 μ broad, and striae 12–15 in 10 μ. Hab. 11, 12.

Navicula menisculus SCHUMANN in HUSTEDT, l.c. p. 301, f. 517, 1930.

Valve elliptic-lanceolate, margin strong convex, ends obtuse and not produced, axial area narrow and linear, central area dilated and rectangular, striae radial in the central part of the valve but slightly convergent at the end, middle striae slightly short. Valve 18 μ long and 7 μ broad, and striae 16 in 10 μ. Hab. 7. The present

specimens resemble *N. anglica* var. *subsalsa* reported by SKVORTZOW from Lake Baical.

var. ***obtusa*** HUSTEDT in FOGED, Biol. Skr. Det. Kongel. Dansk. Vid. Selsk. **11**:1, p. 61, pl. 5, f. 7, 1959.

Valve 22 μ long, 6 μ broad, and striae 15 in 10 μ. Hab. 11.

Navicula mutica KÜTZ. in HUSTEDT, l.c. p. 274, f. 453a, 1930.

Valve variable, lonceolate to elliptic-lanceolate, ends obtuse and rounded, central area transversely rectangular, striae of this place very short with a distinct puncta on one side, striae of the other part of the valve radial, about 17–20 in 10 μ, valve 20–34 μ long, 8 μ broad. The specimen I have observed has a triundulate lateral margin. Hab. 19.

Navicula pupula KÜTZ. var. ***capitata*** HUSTEDT in l.c. p. 281, f. 467c, 1930.

Valve 19–26 μ long, 7–8 μ broad, and striae 18–20 in 10 μ. Striae radial but central ones are irregularly short and slightly separated from each other compared with the rest. Hab. 3.

Navicula salinarum GRUN. in HUSTEDT, l.c. p. 295, f. 498, 1930.

Valve 40 μ long, 9–10 μ broad, and striae 14 in 10 μ. Hab. 12.

Navicula viridula KÜTZ. var. ***slevicensis*** (GRUN.) CLEVE in HUSTEDT, l.c. p. 297, 1930.

Valve linear in outline and acuminate at the pole, both margins almost straight or very slightly convex, end part of the valve slightly produced and rounded at the extremity, axial area very narrow and linear, dilated at the central part of the valve, striae radial at the centre and central striae slightly and more separated from each other than the rest, striae convergent near the end. Valve 37–42 μ long, 8.5–9 μ broad, and striae 11 in 10 μ. The nearest form to this species has been reported by FOGED from Afghanistan as *Navicula* sp., but the present species is slightly broader than the FOGED's form. Hab. 7.

Pinnularia leptosoma GRUN. in HUSTEDT, l.c. p. 316, f. 567, 1930.

Valve narrow-lanceolate linear, central part with a broad fascia, axial area narrow and gradually dilated toward the central part, striae dense and radial, about 22–24 in 10 μ. Valve 29 μ long and 5.5 μ broad. Hab. 11.

Pinnularia microstauron (EHRENB.) CLEVE var. ***Brebissonii*** (KÜTZ.) HUSTEDT in l.c. p. 321, f. 584, 1930.

Valve 34–56 μ long, 10–13.5 μ broad, and striae 12 in 10 μ. Hab. 3, 11, 19.

Cymbellaceae

Amphora ovalis KÜTZ. in HUSTEDT, l.c. p. 342, f. 628, 1930.

Valve 68 μ long, 13.5 μ broad, and striae 12 in 10 μ. Hab. 9.

Cymbella affinis KÜTZ. in HUSTEDT, l.c. p. 362, f. 671, 1930.

Valve 26–41 μ long, 8.8–9.5 μ broad, and striae 9–11 in ventral side and 6–8 in dorsal side in 10 μ. Hab. 1, 2, 7, 10, 11.

var. ***excisa*** (KÜTZ.) GRUN. in HIRANO, Kyoto Univ. Sci. Exp. Karak. Hind. **3**, p. 197, pl. 8, f. 8, 9, 1964.

Valve 32–35 μ long, 8–9 μ broad, and striae 8 in 10 μ. Hab. 7, 10.

Cymbella amphicephala NÄG. var. ***intermedia*** A. CLEVE in K. V. Akad. Handl. **5**:4, p. 151, f. 1223d-f, 1955.

Valve subelliptic, slightly unsymmetric with slightly produced and rounded poles, ventral margin slightly convex in the middle, dorsal margin convex, raphe slightly excentric in disposition, almost straight, axial area narrow lanceolate, slightly dilated in the middle on both sides, striae slightly radial, slightly denser in ventral side than in the dorsal one. Valve 22–24 μ long, 8.5–9.5 μ broad, and striae 12 in 10 μ. The present specimens have a slightly smaller dimension than the one given by A. CLEVE in the north European specimens. The species differs from *C. cuspidata* by the smaller dimension and the form of the central area of the valve which is distinctly elliptic. Hab. 1, 3, 5.

Cymbella aspera (EHRENB.) CLEVE in HUSTEDT, l.c. p. 365, f. 680, 1930.

Valve 107 μ long, 23 μ broad, and striae 18 in 10 μ. Hab. 1.

Cymbella austriaca GRUN. in HUSTEDT, l.c. p. 354, f. 647, 1930.

Valve 41–50 μ long, 10.5–11.6 μ broad, and striae 10–12 in 10 μ. Hab. 1, 19.

Cymbella cistula (HEMPR.) GRUN. in HUSTEDT, l.c. p. 363, f. 676a, 1930.

Ventral margin of the valve slightly tumid in the middle, dorsal margin strongly convex, end part of the valve not recurved, broadly rounded at the extremity, central part of the axial area distinctly dilated into the rhomboid-elliptic form. Striae slightly radial, with two isolated punctae in the centre on the ventral side. Valve 51–56 μ long, 13.5 μ broad, and striae 12 in dorsal side and 9–10 in ventral side in 10 μ. Hab. 1, 19.

Cymbella cymbiformis KÜTZ. var. ***Jimboi*** (PANT.) A. CLEVE in l.c. **5**:4, p. 160, f. 1246g, 1955.

Valve slightly swollen in the middle on the ventral side, gradually attenuated toward the end which is broadly rounded, raphe curved especially near the central part on the ventral side, axial area narrow, not expanded in the middle, striae radial, ventral striae slightly densely disposed than the dorsal one and middle two striae are short and each with an isolated puncta, striae 7 in 10 μ in the middle of the dorsal side, and 10 in 10 μ near the end on the same side. Valve 52–74 μ long and 11–12 μ broad. Hab. 10.

var. ***nonpunctata*** FONTELL in A. CLEVE, l.c. **5**:4, p. 160, f. 1246e, f. 1955.

Valve 68–70 μ long, 15 μ broad, and striae 12 in 10 μ. Hab. 2.

Cymbella differta (A. CLEVE) KRIEGER in Ber. dtsch. Bot. Ges. **61**, p. 263, f. 7–10, 1944.

Valve elongate-subelliptic with rostrated ends, ventral margin slightly convex and slightly triundulate on the relatively long form but flattened on the shorter form, dorsal margin convex, axial area narrow and linear, dilated at the centre, central area slightly elongate-rhomboidal, striae radial, dorsal side being slightly coarser than the ventral and also than the end part of the valve. Valve 22–44 μ long, 10–11 μ broad, and striae 12 on the ventral side and 9–10 on the dorsal one in 10 μ. The present specimens show a considerably wide variation. In shorter forms the valve form resembles *Cymbella amphicephala* var. *intermedia*. I have observed the continuing variation from the shorter to the long forms. The ventral margins of the valve in my specimens do not show a straight side as described by HUSTEDT but a slight convex side. This species has already been known from Lake "Takern-see" as a fossil diatom. Hab. 1, 3, 7, 11, 15.

Cymbella Ehrenbergii KÜTZ. in HUSTEDT, l.c. p. 356, f. 656, 1930.

Valve 134 μ long, 40 μ broad, and striae 12 in 10 μ. Hab. 10.

Cymbella helvetica KÜTZ. var. ***compacta*** (ÖSTR.) HUSTEDT in FOGED, Biol. Skr. Det. Kongel. Vid. Selsk. **11**:1, p. 72, pl. 9, f. 7, 1959.

Valve 34–60 μ long, 12.5–14.5 μ broad, and striae 9 in 10 μ. Hab. 7, 15.

Cymbella microcephala GRUN. in HUSTEDT, l.c. p. 351, f. 637, 1930.

Valve 16 μ long. 3.5 μ broad. Hab. 1, 10.

Cymbella prostrata (BERKELEY) CLEVE in HUSTEDT, l.c. p. 357, f. 659, 1930.

Valve 61 μ long, 22 μ broad, and striae 9–10 in 10 μ. Hab. 2, 4.

Cymbella sinuata GREGORY in HUSTEDT, l.c. p. 361, f. 668a, b. 1930.

Valve 16–22 μ long, 4.5–6 μ broad, and striae 12 in 10 μ . Hab. 4, 7.

Cymbella ventricosa KÜTZ. in A. CLEVE, l.c. **5**:4, p. 124, f. 1177 a-c, 1955 (as var. *genuina* MAYER)

Valve semielliptic, ventral margin almost straight but faintly inflated in the middle, end slightly curved toward the ventral side, axial area narrow and linear, very slightly dilated in the central area on the dorsal side. Valve 22 μ long, 7.7 μ broad, and striae 12 in 10 μ. Hab. 1, 7.

var. ***silesiaca*** (BLEISCH) A. CLEVE in l.c. **5**:4, p. 124, f. 1177 d-f, 1955.

Valve with a distinct incurved pole at each end, the size of the valve slightly smaller than that of the typical form. Valve 24 μ long, 7 μ broad, and striae 9–10 in 10 μ. Hab. 1, 7, 12.

Gomphonema acuminatum EHRENB. in A. CLEVE, l.c. **5**:4, p. 173, f. 1262a, b, 1955. (as var. genuinum)

Valve 26–40 μ long, 10–11 μ broad, and striae 11 in 10 μ. Hab. 9.

Gomphonema angustatum (KÜTZ.) RABENH. in FRICKE Altas Diat. pl. 234, f. 20, 1902; HUSTEDT, l.c. p. 373, f. 690, 1930.

Valve 17–36 μ long, 5.6–8.5 μ broad, and striae 12 in 10 μ. Hab. 2, 4, 5, 7, 9, 11.

var. ***productum*** GRUN. in A. CLEVE, l.c. **5**:4, p. 179, f. 1270g, 1955.

Valve somewhat linear-lanceolate, distinctly heteropolar, both polar ends slightly produced and capitate, axial area narrow and linear not widened at the central node, striae disposed roughly with somewhat irregular distance from each other. Valve 16 μ long, 5 μ broad, and striae 13 in 10 μ. Hab. 7. The present specimens resemble *Gomphonema angustatum* var. *aequalis* figured by FRICKE on the Atlas Diatomaceen pl. 234, f. 27 and 29, 1902.

Gomphonema constrictum EHRENB. var. **capitatum** (EHRENB.) CLEVE in A. CLEVE, l.c. **5**:4, p. 173, f. 1261,e, f, 1955.

Valve 32–36 μ long, 9.5–12 μ broad, and striae 9–10 in 10 μ. Hab. 1.

Gomphonema intricatum KÜTZ. in HUSTEDT, l.c. p. 375, f. 697, 1930.

Valve 35–36 μ long, 6 μ broad, and striae 12 in 10 μ. Hab 7, 13.

var. ***pumila*** GRUN. in HUSTEDT, l.c. p. 375, f. 699, 1930.

Valve 19–26 μ long, 5–5.5 μ broad, and striae 12 in 10 μ. Hab. 1, 3, 7, 9. 11.

Gomphonema lanceolatum EHRENB. in HUSTEDT, l.c. p. 376, f. 700, 1930.

Valve 26–48 μ long, 5–10 μ broad, and striae 12 in 10 μ. Hab. 1, 2, 3, 5, 12.

Gomphonema olivaceum (LYNGB.) KÜTZ. in A. CLEVE, l.c. **5**:4, p. 191, f. 1291a-c, 1955 (as var. balticum Cl.); HUSTEDT, l.c. p. 378, f. 719, 1930.

Valve heteropolar, ovate-lanceolate, anterior pole broadly rounded, posterior pole acutely rounded, axial area narrow-linear, suddenly widened at the central part of the valve into a transversely rectangular form, striae radial but shortened at the centre. Valve 20.5–25.5 μ long, 7 μ broad, and striae 9 in 10 μ. Hab. 7, 19.

Gomphonema parvulum (KÜTZ.) V. H. in A. CLEVE, l.c. **5**:4, p. 177, f. 1269a-c, 1955. (as var. genuinum MAYER)

Valve heteropolar, lanceolate-elliptic, axial area narrow and linear, not widened at the centre, striae almost horizontal, central stria with an isolated stigma on one side and with a short stria on the opposite side. Valve 18–26 μ long, 5.5–8.5 μ broad, and striae 12 in 10 μ. Hab. 3, 5, 7, 11, 12.

var. ***micropus*** (KÜTZ.) CLEVE in HUSTEDT, l.c. p. 373, f. 713c, 1930.

Valve ovate-lanceolate, both ends slightly produced, axial area narrow-lanceolate, not narrow linear as given by HUSTEDT so that the present specimens somewhat resemble the short form of *Gomphonema Clevei* as figured by FOGED for the material of Afghanistan. Valve 14 μ long, 4.5 μ broad, and striae 12 in 10 μ. Hab. 5, 7.

Epithemiaceae

Rhopalodia gibberula (EHRENB.) O. MÜLL. var. ***producta*** (GRUN.) A. CLEVE in l.c. **3**:3, p. 43, f. 1415d-i, 1952.

Valve 50–76 μ long, 8–9 μ broad. Hab. 13.

Nitzschiaceae

Hantzschia amphioxys (EHRENB.) GRUN. in HUSTEDT, l.c. p. 394, f. 747, 1930.

Valve 43–68 μ long, 8–9 μ broad, and striae 18–20 in 10 μ. Hab. 1, 3, 5, 7, 11.

Nitzschia apiculata (GREGORY) GRUN. in HUSTEDT, l.c. p. 401, f. 765, 1930.

Valve narrow and linear, margins slightly retuse in the middle, ends acuminate, rounded at the extremity, striae broken in the middle. Valve 40–45 μ long, 6–6.5 μ broad, and striae 14 in 10 μ. Hab. 1, 7.

Nitzschia denticula GRUN. in HUSTEDT, l.c. p. 407, f. 780, 1930.

Valve 30–32 μ long, 4–7 μ broad, and striae 15 in 10 μ. Hab. 1.

Nitzschia dissipata (KÜTZ.) GRUN. in HUSTEDT, l.c. p. 412, f. 789, 1930.

Valve 28–30 μ long, 3.5 μ broad. Hab. 1.

Nitzschia fonticola GRUN. in HUSTEDT, l.c. p. 415, f. 800, 1930.

Valve 12–19 μ long, 3–4 μ broad, and striae 12 in 10 μ. Hab. 1, 5, 11.

var. ***romana*** (GRUN.) A. CLEVE in l.c. **3**:3, p. 89, f. 1500d-h, 1952.

Valve 30–35 μ long, 5.5–6 μ broad. Hab. 11, 19.

Nitzschia frustulum (KÜTZ.) GRUN. var. ***subsalina*** HUSTEDT in l.c. p. 415, f. 796, 1930.

Valve 11–25 μ long, 4 μ broad. Hab. 5.

Nitzschia hungarica GRUN. in HUSTEDT, l.c. p. 401, f. 766, 1930.

Valve linear, median part with parallel sides, end part acuminate, extremity obtusely rounded, striae distinct, each stria is broken in the middle and is seen like a longitudinal line. Valve 34–60 μ long, 7.5–8.5 μ broad, and striae 12 in 10 μ. Hab. 19.

Nitzschia Kutzingiana HILSE in A. CLEVE, l.c. **3**:3, p. 91, f. 1505a-c, 1952 (as var. genuina A. Cl.)

Valve 27 μ long, 7 μ broad. Hab. 1, 3.

Nitzschia linearis W. SMITH in HUSTEDT, l.c. p. 409, f. 784, 1930.

Valve long linear with parallel sides, kiel puncta short, aequidistant, striae densely disposed, not counted. Valve 75–106 μ long, 5–6 μ broad. Hab. 1, 3, 4, 5, 13.

Nitzschia palea (KÜTZ.) W. SM. in HUSTEDT, l.c. p. 416, f. 801, 1930.
Valve 28–32 μ long, 3.5–5 μ broad. Hab. 5, 13.

Nitzschia perminuta GRUN. in KOBAYASHI, Chichibu Mus. Nat. Hist. no. 12, p. 75, pl. 17, f. 78, 1964.
Valve 13–17 μ long, 2–3.5 μ broad, and striae 24–25 in 10 μ. Hab. 1.

Nitzschia sigmoidea (EHRENB.) W. SMITH in HUSTEDT, l.c. p. 419, f. 810, 1930.
Valve 160–272 μ long, 10–12.5 μ broad, and striae about 40 in 10 μ. Hab. 1, 3, 4, 7, 19.

Nitzschia sinuata (W. SM.) GRUN. in HUSTEDT, l.c. p. 408, f. 781, 1930.
Valve 40 μ long, 8 μ broad, and striae 18 in 10 μ. Hab. 1, 7.

Nitzschia sublinearis HUSTEDT in l.c. p. 411, f. 786, 1930.
Valve linear-lanceolate with the parallel sides, gradually narrowed to the apices which are truncately rounded at the extremity and are slightly capitate, kiel punctae 13–14 in 10 μ, striae many and delicate. Valve 28–68 μ long, 3.5–7 μ broad. Hab. 1, 3, 7, 11, 13, 19.

Nitzschia thermalis KÜTZ. in HUSTEDT, l.c. p. 403, f. 771, 1930.
Valve 74 μ long, 7 μ broad. Hab.

Surirellaceae

Cymatopleura elliptica (BRÉB.) W. SM. in HUSTEDT, l.c. p. 426, f. 825, 1930.
Valve 70–97 μ long, 50–52 μ broad. Hab. 2. 5, 7, 9, 11, 12.

Cymatopleura solea (BRÉB.) W. SM. in HUSTEDT, l.c. p. 425, f. 823a, 1930.
Valve 50–100 μ long, 15–28 μ broad. Hab. 1, 2, 3, 11, 19.

Surirella angustata KÜTZ. in HUSTEDT, l.c. p. 435, f. 844, 845, 1930.
Valve 24–51 μ long, 7.6–8.5 μ broad. Hab. 1, 2, 5, 7, 13, 19.

Surirella ovalis BRÉB. in HUSTEDT, l.c. p. 441, f. 860, 861, 1930.
Valve 41–45 μ long, 21–23 μ broad, and striae 15 in 10 μ. Hab. 8, 13, 19.

Surirella ovata KÜTZ. var. ***pinnata*** (W. SM.) HUSTEDT in A. Cleve, K. V. Akad. Handl. **3**:3, p. 122, f. 1566g, h, 1952.
Valve 40 μ long, 10 μ broad. Hab. 7.

Surirella tenella GREGORY var. ***pusilla*** A. MAYER in Denkschr. Bayer Bot. Ges. 13, N.F. 7, p. 68, pl. 8, f. 12, 1915.
Valve 34 μ long, 10 μ broad. Hab. 7.

Plate 1

1-3. *Synedra ulna* (NITZSCH) EHRENB.
4. *Diploneis marginestriata* HUSTEDT
5. *Cymbella ventricosa* KÜTZ. var. *silesiaca* (BLEISCH) A. CLEVE
6. *Navicula menisculus* SCHUMANN
7, 8. *Navicula koeiei* FOGED
9, 10. *Navicula salinarum* GRUN.
11, 12. *Navicula cryptocephala* KÜTZ.
13. *Navicula cryptocephala* var. *exilis* (KÜTZ.) GRUN.
14. *Navicula cryptocephala* var. *intermedia* GRUN.
15, 16. *Navicula cryptocephala* var. *veneta* (KÜTZ.) GRUN.
17. *Neidium dubium* (EHRENB.) CLEVE
18. *Caloneis bacillum* (GRUN.) MERESCHK.

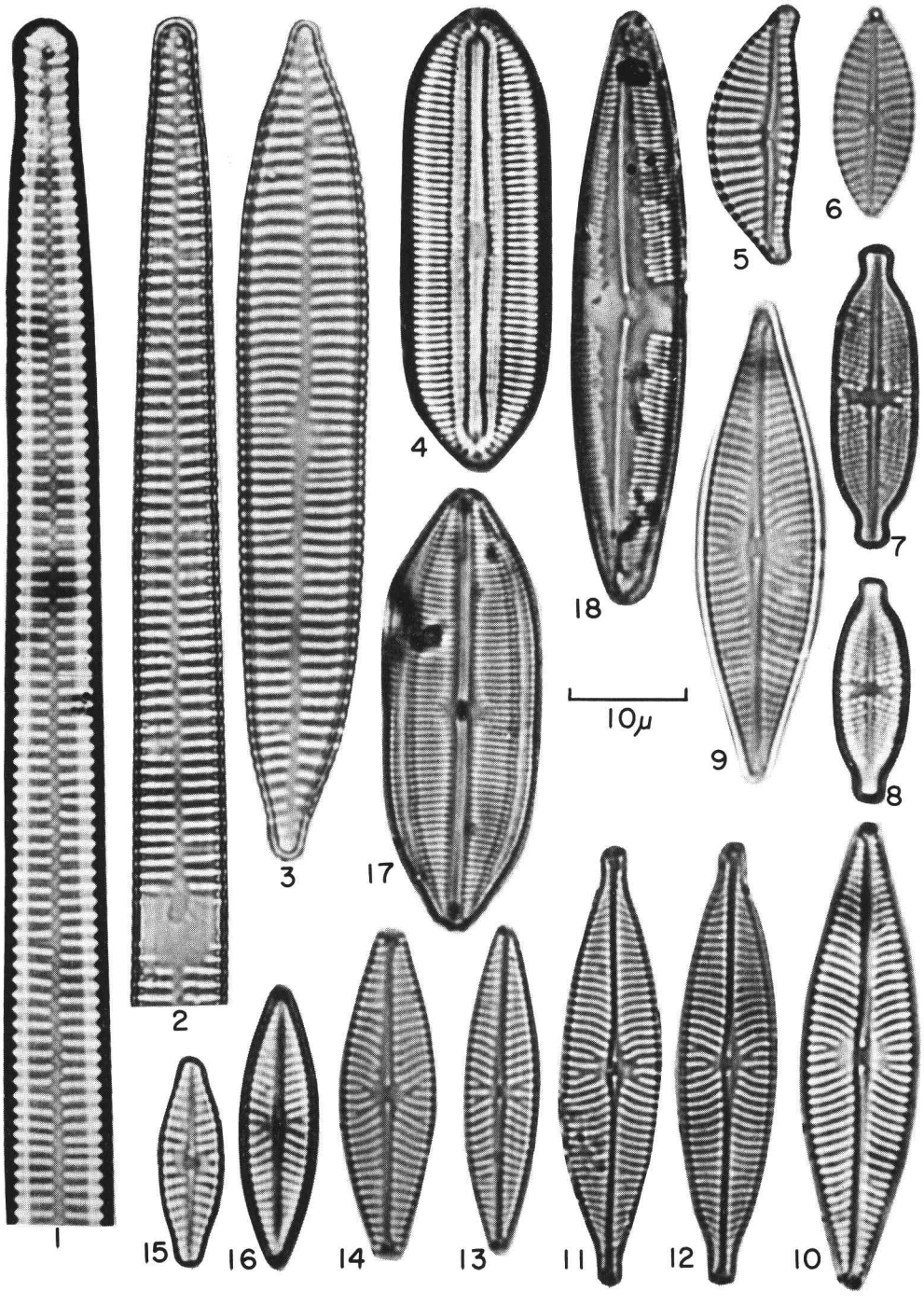
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Plate 2

1-8. *Cymbella differta* (A. CLEVE) KRIEGER

9–11. *Pinnularia microstauron* (EHRENB.) CLEVE var. *Brebissonii* (KÜTZ.) HUSTEDT

12. *Cymbella amphicephala* NÄG. var. *intermedia* A. CLEVE

13. *Gomphonema angustatum* (KG.) RABENH. var. *productum* GRUN.

14. *Navicula gracilis* EHRENB.

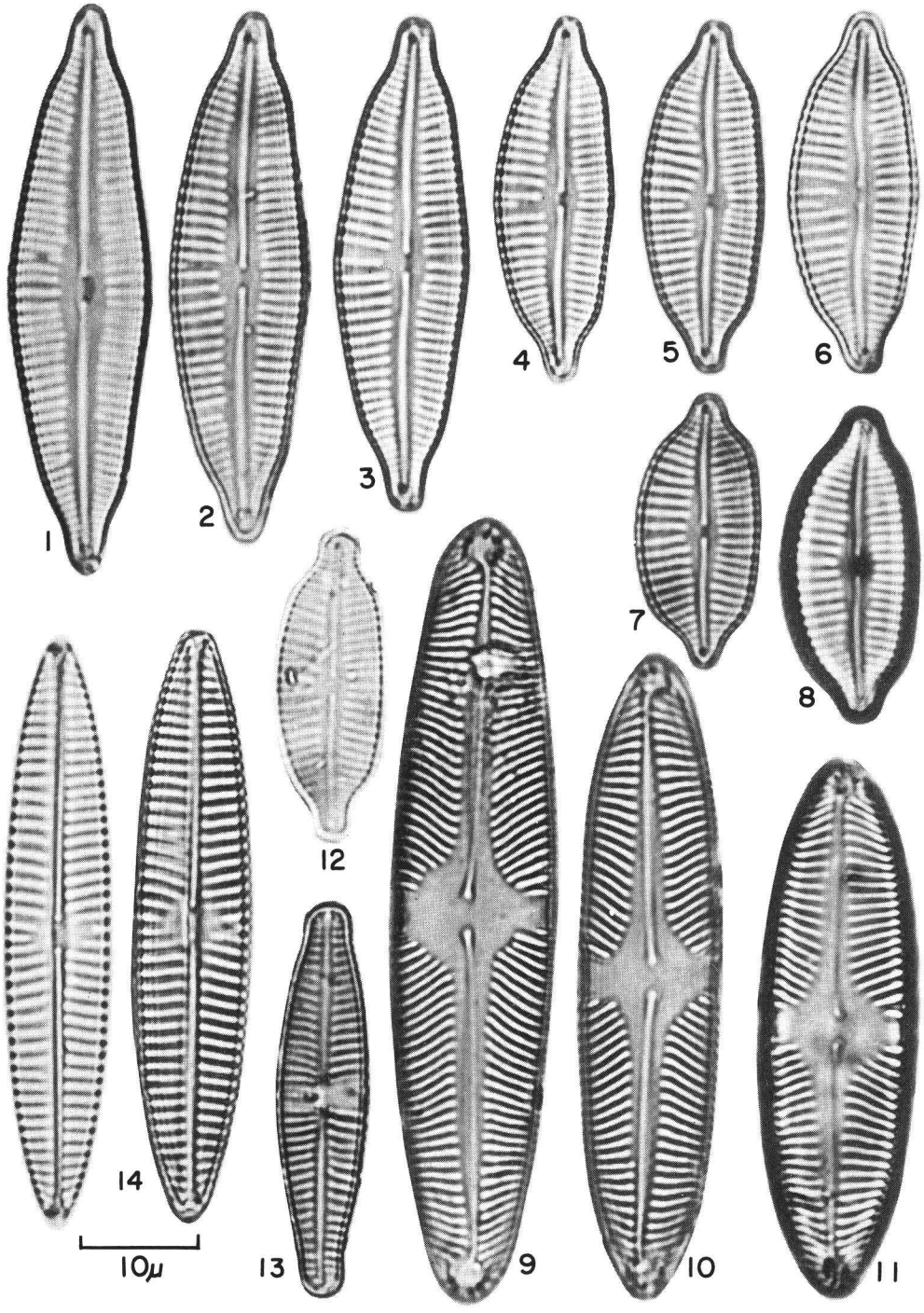
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Plate 3

1, 2. *Cymbella cymbiformis* KÜTZ. var. *nonpunctata* FONTELL

3, 4. *Cymbella helvetica* KÜTZ. var. *compacta* (ÖSTR.) HUSTEDT

5. *Gomphonema intricatum* KÜTZ.

6. *Gomphonema angustatum* (KÜTZ.) RABENH. var. *productum* GRUN.

7. *Gomphonema lanceolatum* EHRENB.

8, 9. *Caloneis silicula* (EHRENB.) CLEVE var. *truncatula* GRUN.

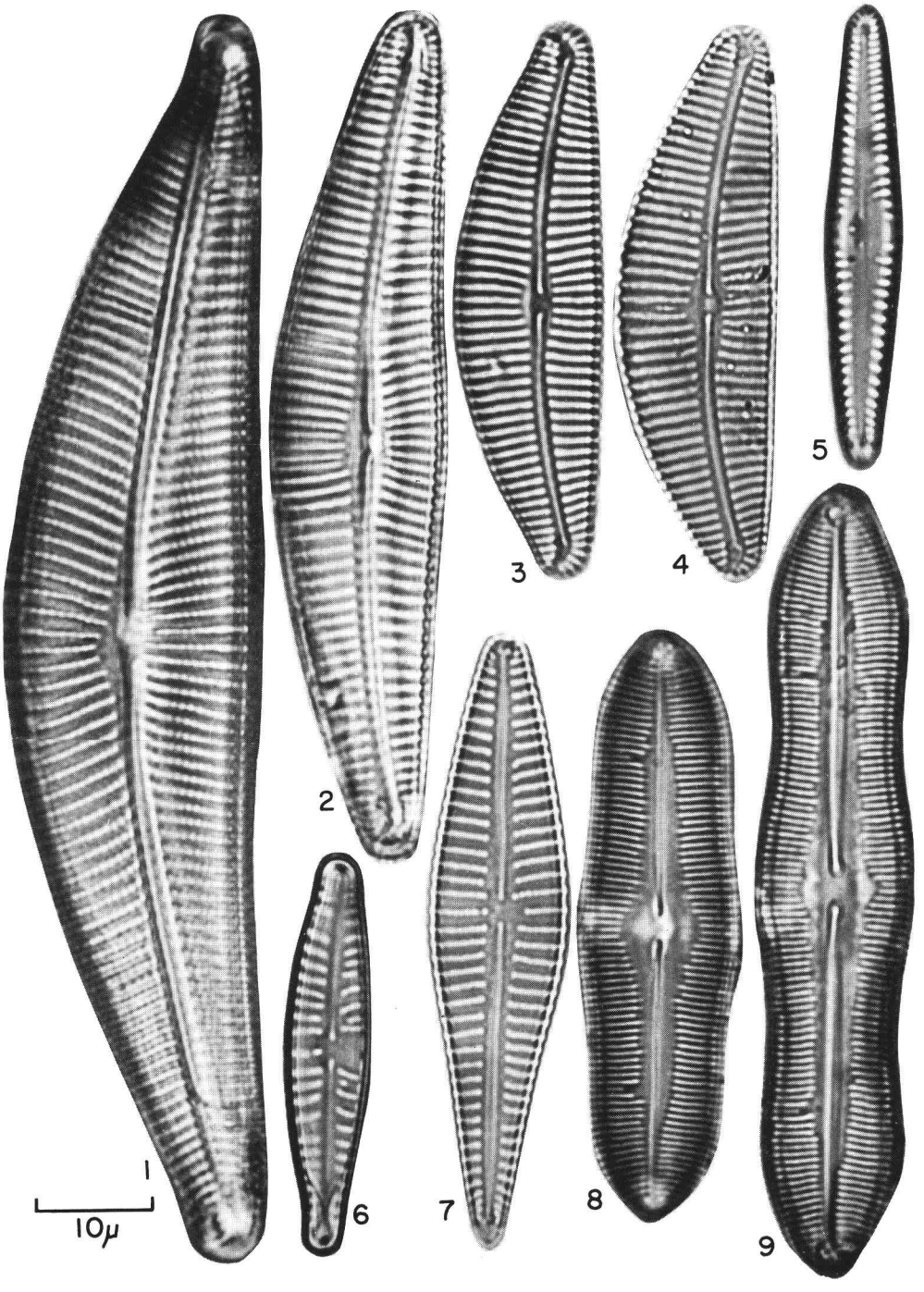
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Plate 4

1. *Cymbella Ehrenbergii* KÜTZ.
2–4. *Cymbella cymbiformis* KÜTZ. var. *Jimboi* (PANT.) A. CLEVE
5–9. *Cymbella ventricosa* KÜTZ.

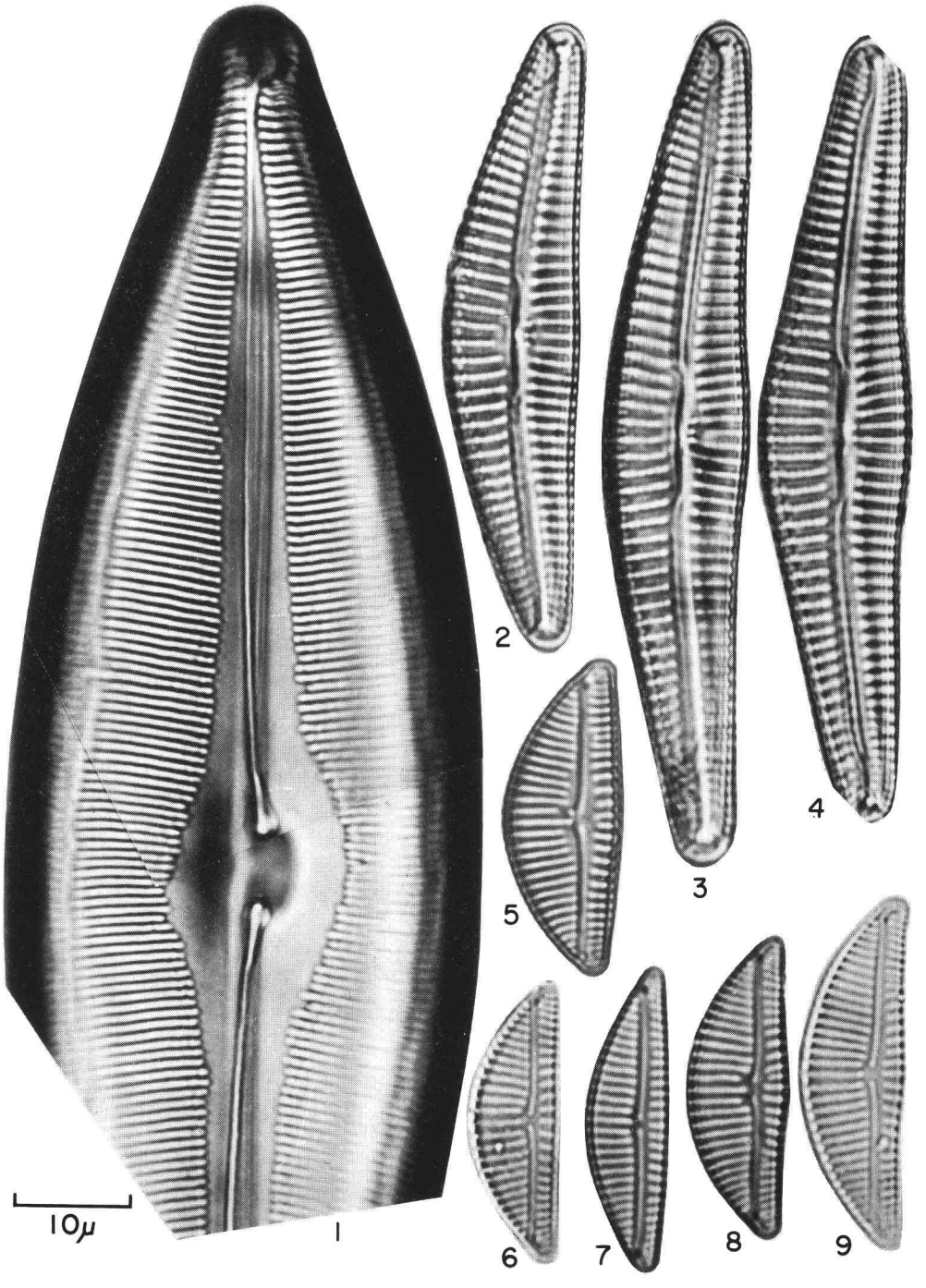
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Plate 5

1–7. *Cymbella affinis* KÜTZ.

8–10. *Cymbella affinis* var. *excisa* (KÜTZ.) GRUN.

11, 12. *Cymbella prostrata* (BERKELEY) CLEVE

13–15. *Cymbella sinuata* GREGORY

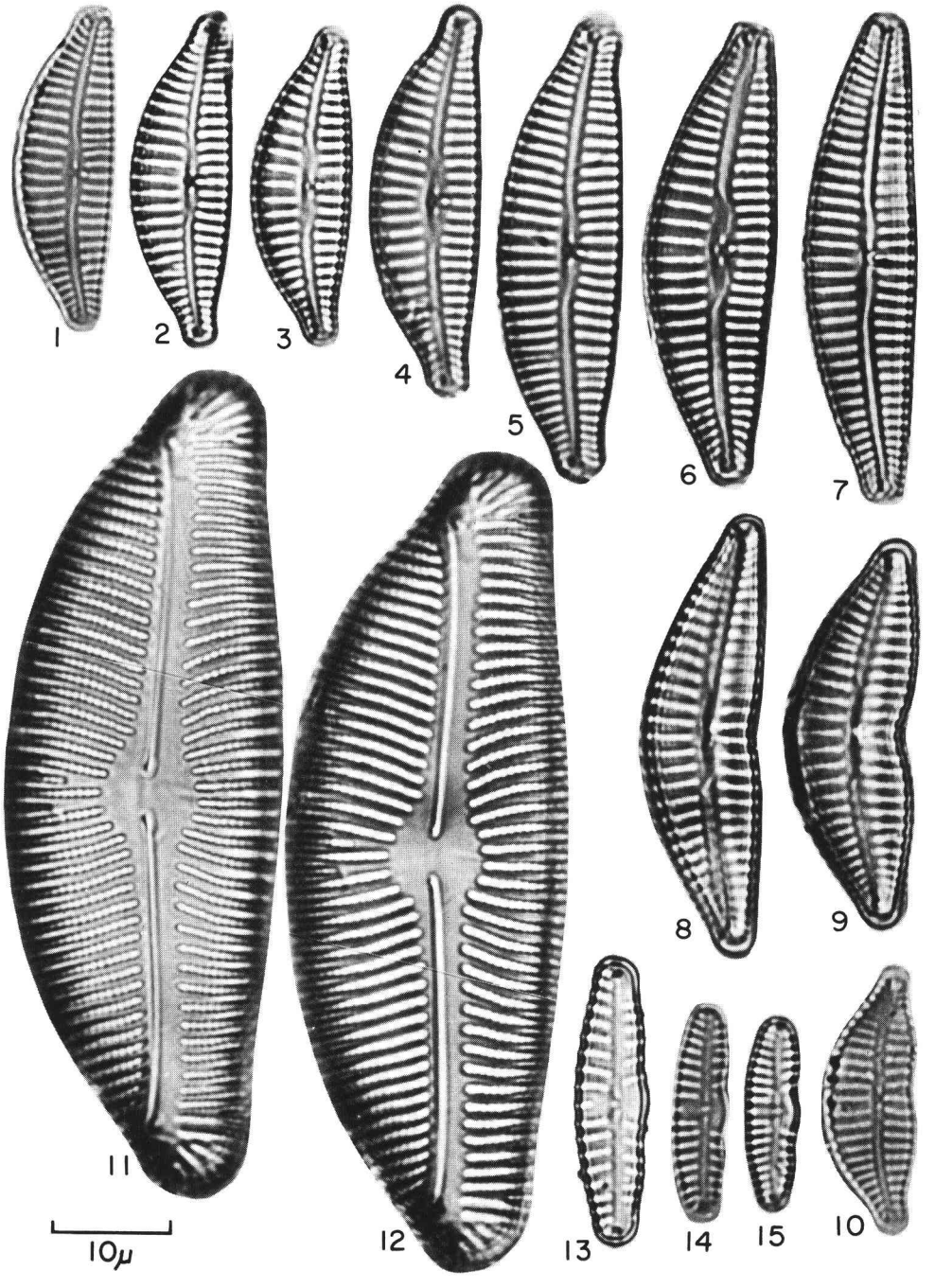
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Plate 6

1–4. *Cymbella cistula* (HEMPR.) GRUN.
5, 6. *Gomphonema acuminatum* EHRENB.
7. *Gomphonema constrictum* EHRENB. var. *capitatum* (EHRENB.) CLEVE
8, 9. *Gomphonema olivaceum* (LYNGB.) KÜTZ.
10. *Stauroneis Smithiii* GRUN. var. *karelica* WISL. & KOLBE
11, 12. *Gomphonema intricatum* KÜTZ. var. *pumila* GRUN.

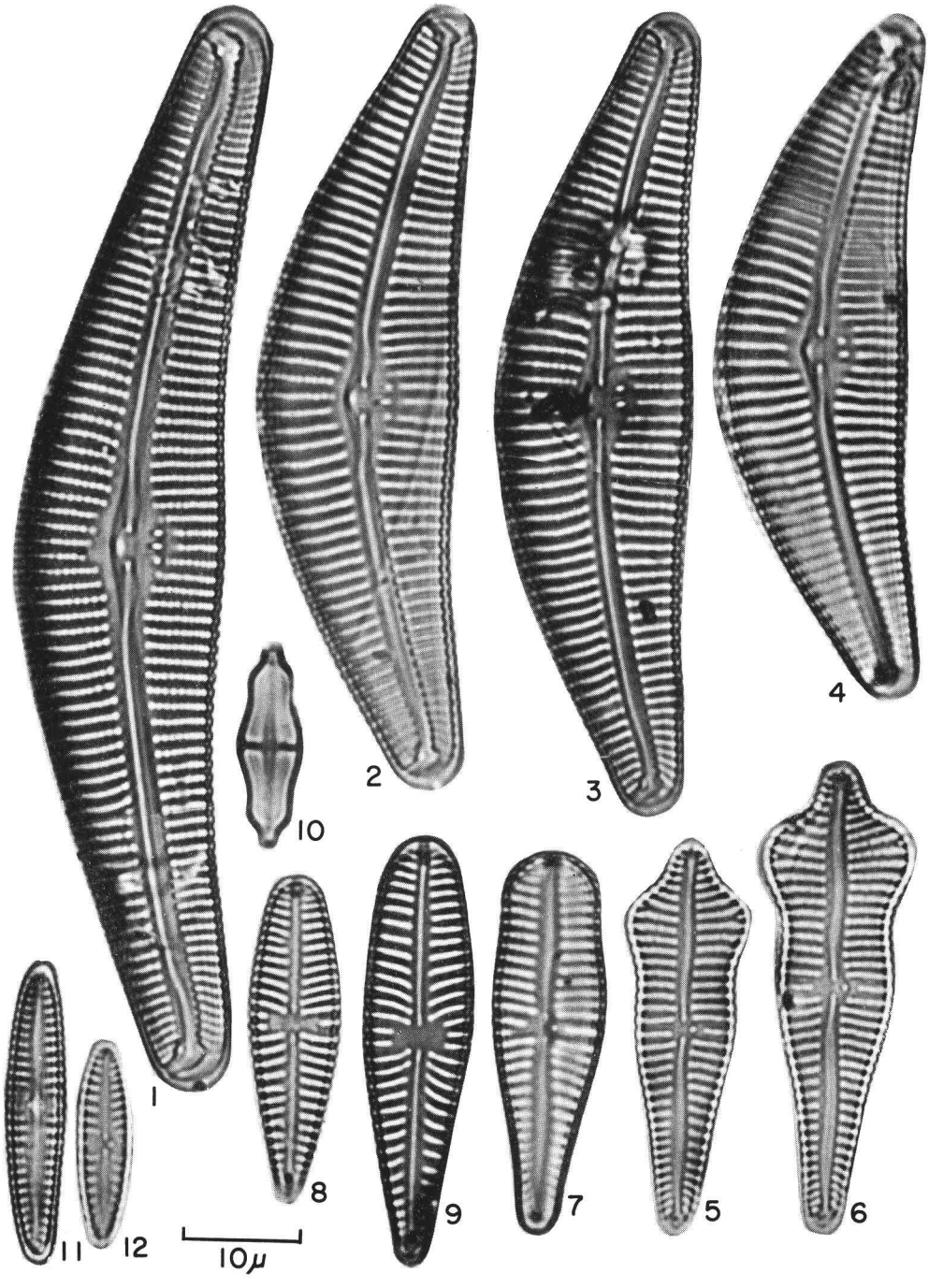
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Plate 7

1. *Nitzschia sigmoidea* (EHRENB.) W. SMITH
2. *Nitzschia linearis* W. SMITH
3. *Nitzschia sublinearis* HUSTEDT
4. *Nitzschia sinuata* (W. SM.) GRUN.
5. *Nitzschia apiculata* (GREGORY) GRUN.
6. *Nitzschia palea* (KÜTZ.) W. SM.

7–9. *Navicula mutica* KÜTZ.

10, 11. *Navicula pupula* KÜTZ. var. *capitata* HUSTEDT

12. *Navicula viridula* KÜTZ. var. *slevicensis* (GRUN.) CLEVE
13. *Nitzschia dissipata* (KÜTZ.) GRUN.
14. *Gomphonema parvulum* (KÜTZ.) V. H.

15, 16. *Nitzschia frustulum* (KÜTZ.) GRUN. var. *subsalina* HUSTEDT

17. *Navicula cuspidata* KG. var. *ambigua* (EHRENB.) CLEVE

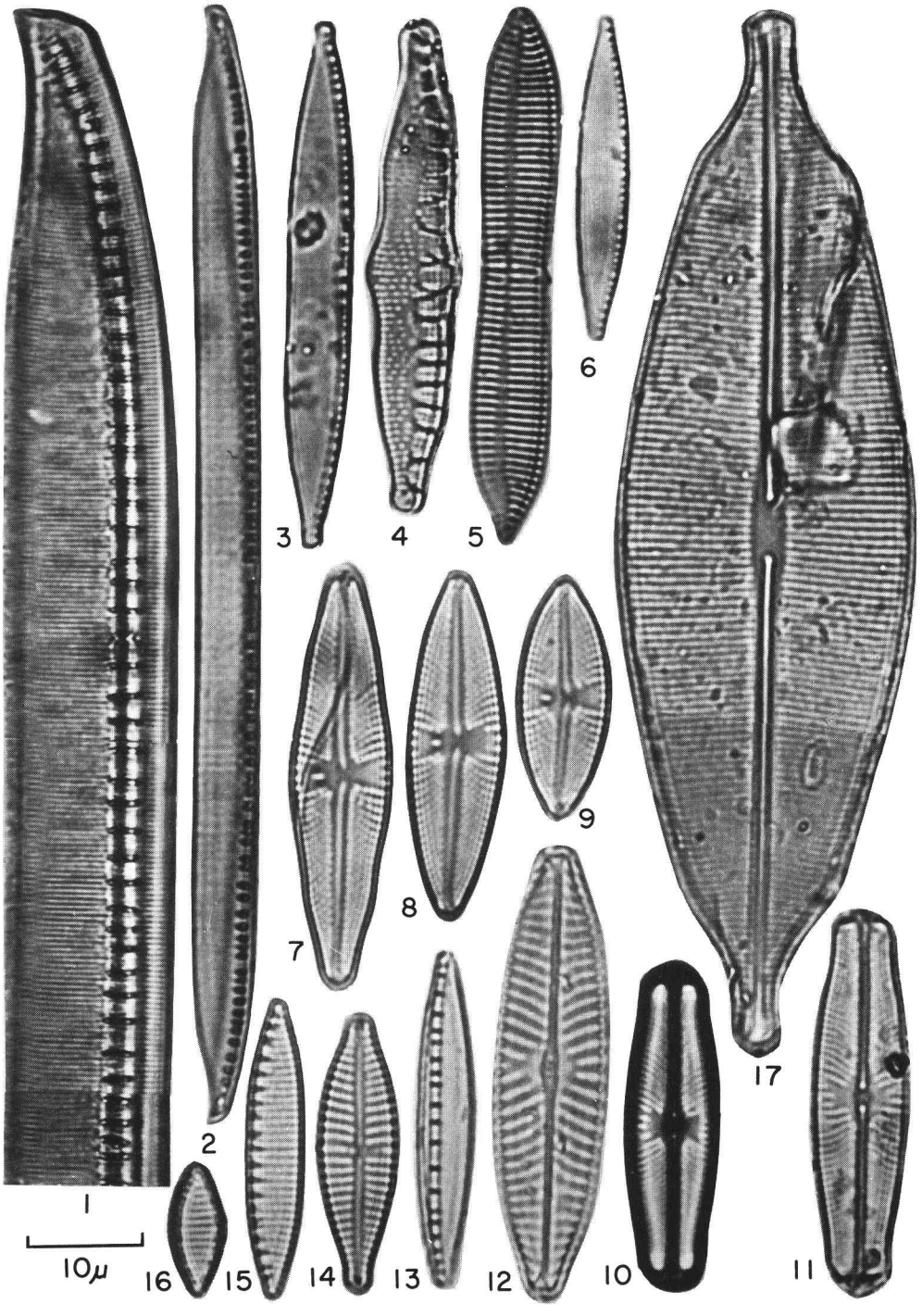
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Plate 8

1, 2. *Cymatopleura solea* (BRÉB.) W. SM.

3, 4. *Surirella angustata* KÜTZ.

5, 6. *Cymatopleura solea* (BRÉB.) W. SM.

7–9. *Nitzschia perminuta* GRUN.

10, 11. *Nitzschia denticula* GRUN.

12, 13. *Gomphonema angustatum* (KÜTZ.) RABENH.

14. *Gomphonema angustatum* var. *producta* GRUN.

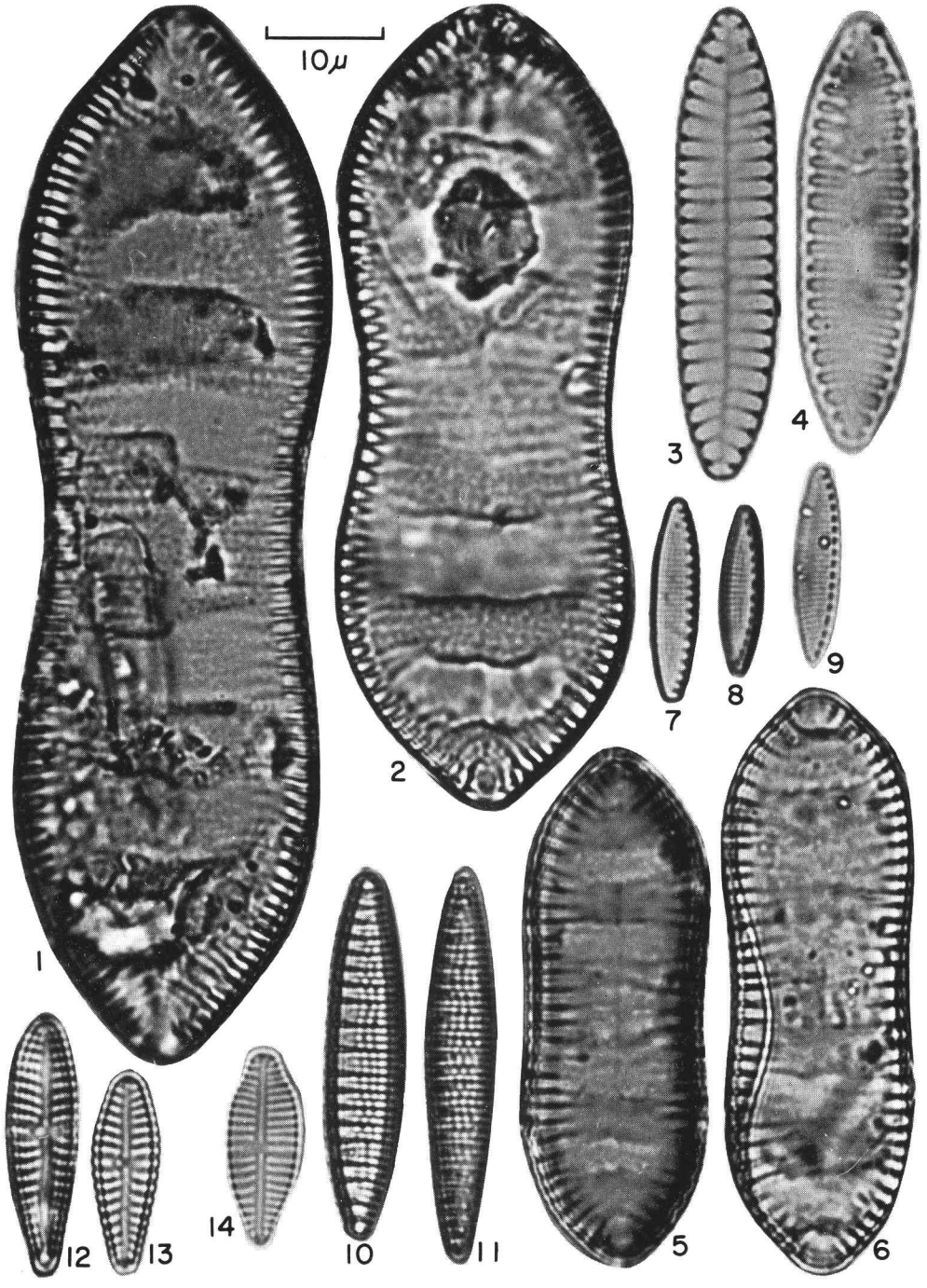
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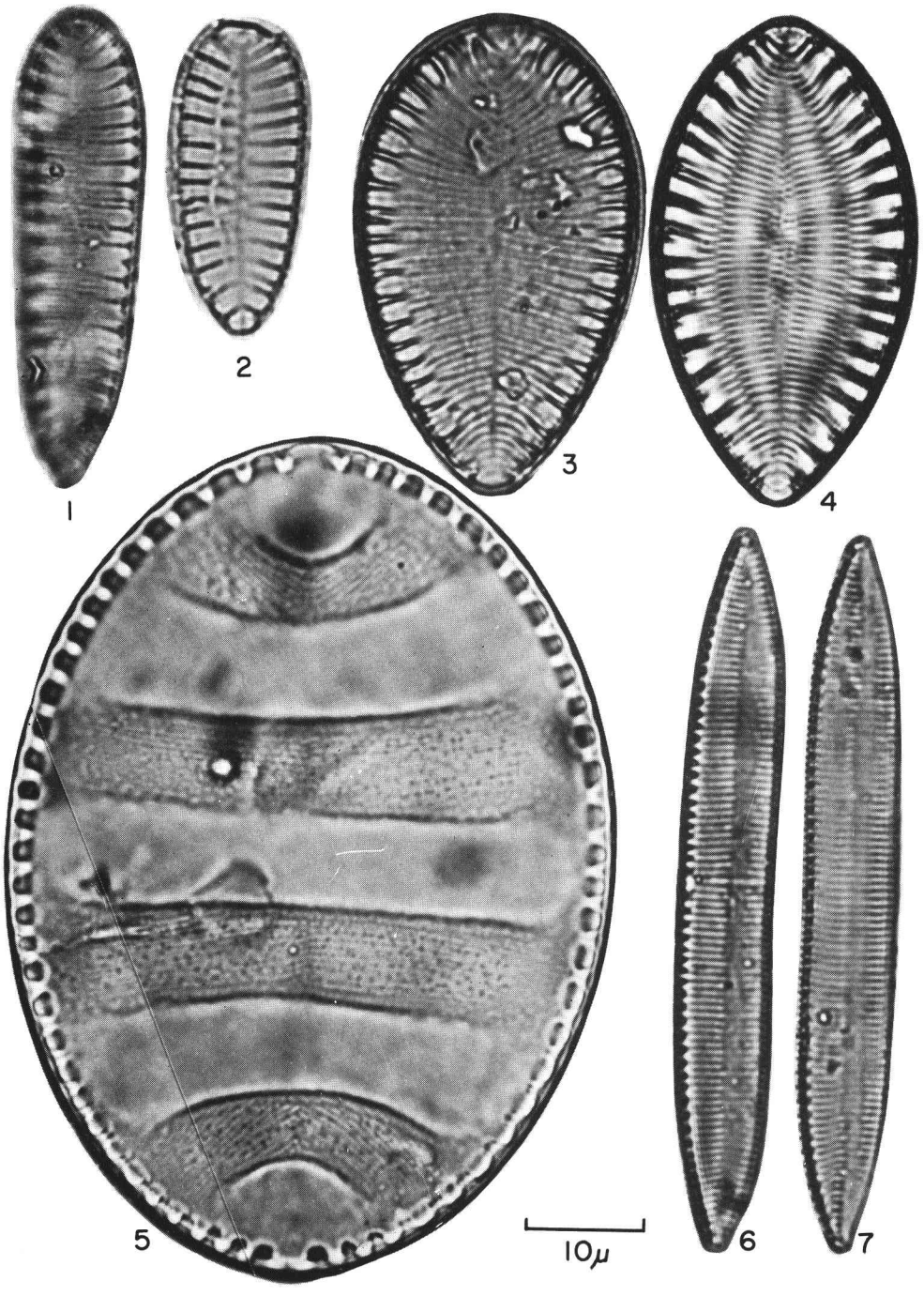
Plate 9

1. *Surirella ovata* KÜTZ. var. *pinnata* (W. SM.) HUSTEDT
2. *Surirella tenella* GREGORY var. *pusilla* A. MAYER

3. 4, *Surirella ovalis* BRÉB.

5. *Cymatopleura elliptica* (BRÉB.) W. SM.

6. 7. *Nitzschia hungarica* GRUN.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